SCIENCE & TECHNOLOGY IN BRITISH COLUMBIA

people make the difference

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People Make The Difference

British Columbia attracts many people because of its beautiful scenery and mild climate. But it attracts scientists, engineers and entrepreneurs because of the programs, facilities and challenges — and, above all, the people — that they find here.

British Columbia has a proven record of innovation in medicine, agriculture, resource recovery and management, transportation and communications. Men and women have made major contributions to human progress. That's what this document is all about — what B.C. has done, can do and will do to advance and apply science and technology. Today, thanks to the existence of strong and broadly based universities, colleges and research institutes, a fast-growing list of private companies in the knowledge sector, and an enlightened government policy on science and technology, the opportunities for innovation in those and other fields are excellent.

Under the blueprint laid down in the government's newly adopted policy, *Strategies for Innovation*, the government is committed to creating a future "where innovation is the norm, not the exception."

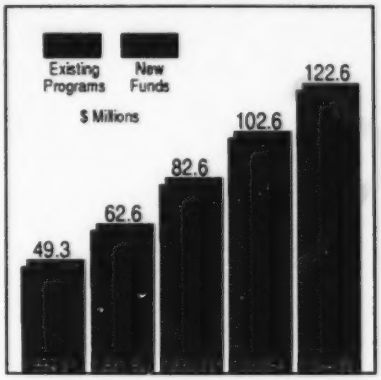
The provincial government has committed substantial funding and the talents of its best people to achieve this goal. The government expects that by the year 2000, B.C. industry, government and institutions will be investing approximately 2.5 percent of provincial output in research and development. That's 3 times the estimated level of research and development in 1989.

BUILDING ON STRENGTHS

British Columbia is larger than any European country except Russia, and any American state except Alaska. Yet its population is relatively small, just over 3 million people. What is happening

President Tae Ri Lee (above) of TRL Microwave Technology Inc. consults with technician. Vice-president Bob Mountford (below) with Daisy Lau and Elsa Larsen in the production centre of Spilsbury Communications Ltd.

5 YEAR EXPENDITURE PROFILE



Science & Technology Fund

The most significant science and technology commitment ever undertaken in British Columbia was announced in the April, 1990, Budget Speech. A new Science & Technology Fund will provide $420 million over five years to support applied research and development. The aim is to make our firms better able to compete internationally and to help them introduce products which are more valuable and so bring more wealth and a better quality of life to the province.

The fund will provide support for:

1. Industry-based research and development with industry contributing at least 50 per cent.
2. Research in key industrial sectors, such as information technology, identified through an industry-led planning process.
3. Special projects, such as research into alternative fuels and the KAON project described on page 25. Particular emphasis will be placed on projects that promote a clean environment and quality of life and on those that have the potential to create high-technology export industries.

Billie Jo Finnson and Gary Kenwood (left) grade western red cedar seedlings for packing at Reid, Collins Nurseries Ltd.

Science & Technology Policy

1. Support the use and development of technological innovations that build on existing strengths and capabilities and have export potential.

2. Encourage the use of science and technology to optimize the quality of life for British Columbians through protecting and improving our natural, man-made, and cultural environments, and do so in a way that produces products and services that can be exported.

3. Recognize the importance of basic research, and encourage applied research of an international calibre in areas that contribute significantly to British Columbia.'s economic development and competitiveness.

4. Foster entrepreneurial enterprises and encourage partnerships among post-secondary institutions, government, industry, and labour that will promote technology transfer and encourage commercialization of the results of our basic and applied research.

5. Support the development of marketing programs that take advantage of British Columbia's unique geographical location and cultural makeup.

6. Strengthen the science and technology components at all levels of the educational system so that scientific and technological literacy is improved, more people are attracted to careers in science and technology, and our universities continue to produce graduates and research of the highest possible calibre.

7. Encourage government, institutions, industry and labour to communicate the benefits of science and technology to the general public so that the public supports science and technology policies and initiatives.

8. Make educational programs available in science and technology to enable retraining, upgrading and acquisition of new knowledge, to ensure an educated and adaptable work force in the trades and professions.

9. Provide a level of direct government financial support for technology-intensive industries that will enable British Columbia to be competitive nationally and internationally.

— from Strategies for Innovation

here is truly remarkable. But people in industry, educational institutions and government realize we can only be leaders in certain scientific or technological areas. The Provincial Policy, then, recommends that we build on our strengths. This means, for example, using technology to make our resource industries — forestry, mining, fishing, agriculture — more efficient and more competitive. It also means applying our skills to adding value to those resources — assembling, processing and building with them here before we use or export them. (For example, see page 15) Adding value to basic resources is a key policy objective, and it is one that will challenge our scientists, technicians, engineers and entrepreneurs, and stimulate the growth of our economy. Guided by the recommendations of a wide spectrum of private sector advisors, the Province also wants to stimulate industries like information processing, biotechnology and advanced materials, which create technology that helps a broad range of other industries, and other key sectors.

And we know we will need many more scientists, technicians, engineers and entrepreneurs to meet the challenge. People are B.C.'s best resource and they are also its most renewable resource. Educational institutions and industry are the instruments of that renewal.

SCIENCE & TECHNOLOGY STRATEGY

The Province's strategy to achieve its policy has four parts:

❖ ***Human resource development***

The most important factor is skilled and innovative people. British Columbia is taking a lead role nationally in efforts to plan and provide for the nation's human resource requirements for knowledge-based industry in the next century, including life-long learning.

❖ ***Research and development***

The industry base is being transformed. More and more, technology is driving traditional resource industries and enabling major new industries, such as computer software. Government policies encourage this transformation.

❖ ***Framework for Action***

People need a framework for action. New and existing institutions are making it easier for people to get things done. The *Science Council of B.C.*, the *Advanced Systems Institute*, the *Premier's Advisory Council on Science & Technology*, and the industry-led planning process known as *SPARK* are key to this infrastructure.

❖ ***Science awareness***

People need to know more about the achievements of the province's scientists and engineers. Knowledge builds support and understanding among the general public. B.C. is well-served by splendid institutions such as *Science World* and programs like *Scientists in the Schools*, which help to explain and interpret scientific principles and the joy of discovery.

NOW, THE SPECIFICS

That's an overview of B.C., a current and future home of world-class science and engineering. The remainder of this report fills in the details of what's happening and who's making it happen.

Construction workers (above) on Alex Fraser bridge. Electron Micrograph of Giant Bay's bacteria eating pyrite(left) — magnified 7500 times. Greg Peet, (below) president of Norsat International Inc. — leaders in satellite dish technology — observes the assembly line.

Human Resource Development

B.C.'s educational institutions are essential partners with government in all aspects of science policy, from basic research to public awareness of the importance of science. But their fundamental role is human resource development, ensuring that B.C. has the trained graduates and experienced and knowledgeable scientists we need to compete in the 21st century.

The Province's advanced education facilities are impressive by any standards. At present, there are three major universities — the *University of British Columbia*, the *University of Victoria* and *Simon Fraser University*, fifteen community colleges and four specialized institutes serving communities from Dawson Creek in the northeast to Victoria in the southwest.

But the picture is changing rapidly. The three established universities are being joined by several other degree-granting institutions, as a fresh demand for higher education available closer to home sweeps across the province. Soon we'll celebrate the opening of the *University of Northern British Columbia* in Prince George, designed to serve people in the interior and northern parts of the province. Meanwhile, full university degree programs are being offered students at community colleges in Kelowna, Kamloops and Nanaimo.

The *B.C. Institute of Technology* in Burnaby offers specialized training in a broad range of skills, while the *Open Learning Agency* uses correspondence and satellite broadcasts to communicate to a vast audience of learners throughout British Columbia.

The three existing universities, the Institute of Technology, and some of the colleges have opened special industry liaison offices to build links between campus researchers and off-campus entrepreneurs. Technology transfer from the university to the marketplace has become big business. The list includes everything from satellite software to a bodysuit to warn paraplegics of the danger of frostbite. More than 70 companies have spun off from the *University of B.C.* alone.

Dr. Tad McGeer (left) of Simon Fraser University School of Engineering explores bipedal robotic locomotion.

THE UNIVERSITY OF BRITISH COLUMBIA

The largest and oldest of British Columbia's universities, the *University of B.C.* sets a high standard for both basic and applied research. From mechanical engineering to zoology, the faculties involved in science and engineering maintain a busy program of research, teaching and community interaction. Currently, the university brings in close to $100 million a year in research grants and contracts, most from national and international competitions based on excellence. At any given time, there are more than 2,000 faculty and 4,000 student research projects underway.

THE UNIVERSITY OF VICTORIA

The clear, dark skies of southern Vancouver Island have attracted astronomers since the early 20th century. Not surprisingly, the pursuit of knowledge about the universe is one of the scientific strengths of the *University of Victoria*.

Marine biology is another. The university is a partner in the *Bamfield Marine Station* on the west coast of the Island, and the recently established engineering faculty has made important contributions to software engineering, database management, operating systems, image processing, digital filter design, computer-aided manufacturing and design and robotics.

SIMON FRASER UNIVERSITY

Simon Fraser's lofty perch atop Burnaby Mountain is an inspiring setting

for the work of 16,000 students and more than 500 faculty members. Industry, business, and government support campus research with upwards of $10 million in annual grants.

Since it opened its doors in 1965 *Simon Fraser University* has developed an extensive array of disciplines in science and engineering. In the new Applied Sciences building, computer scientists and engineers break new ground in circuit design, artificial intelligence and expert systems, and robotics.

A downtown campus that debuted in 1989 is opening doors to new knowledge and skills for mature and continuing students, and there are plans for more satellites in the Fraser Valley.

Students (above) study at the University of British Columbia library. At International Submarine Engineering Ltd,. (below) a technician checks a remote controlled submersible.

B.C. INSTITUTE OF TECHNOLOGY

The *B.C. Institute of Technology* offers well respected diploma programs. In engineering technology, programs include biotechnology, computer-assisted design and manufacturing, microcomputer systems, robotics and automation, pulp and paper, and building technology. On the health sciences side, there are programs in such fields as biomedical engineering, nuclear medicine technology, environmental health and general nursing. The Institute also offers a unique course in advanced technology marketing.

THE OPEN LEARNING AGENCY

The term "open learning" was first used in 1969 to describe the self-paced, independent study university courses offered by the *British Open University*. It breaks down many of the traditional barriers to learning — complicated prerequisite requirements, time, and distance. Students are able to learn when and what they want. Open learning came to B.C. in 1978. Now, under the *Open Learning Agency*, there are close to 50,000 annual course enrollments.

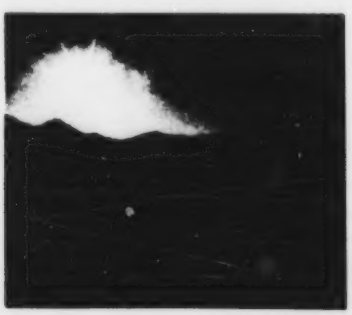
TECHNOLOGY AND THE LABOUR FORCE

In order to remain competitive in an age of advancing technology and globalization of markets, higher than ever levels of knowledge and skills are necessary. Based on current projections, 86 per cent of new jobs created in B.C. to 1993 will require 12 or more years of education and training. Over the next decade, two-thirds of new jobs will require 17 or more years of formal education and training.

The occupational focus is shifting from resource-based industries to more information-intensive industries such as manufacturing, services, transportation, communications and utilities, finance, insurance, real estate and trade.

To maintain and improve productivity, there must be commitment to training scientists and researchers to develop and adapt technologies, and training and upgrading of the workers who use this technology.

Through education — elementary, secondary, and post-secondary — training, and upgrading, British Columbians can and will attain the skill levels necessary to remain competitive in today's technology-intensive labour market.



Research And Development

INFORMATION TECHNOLOGY

This sector, combining electronics and software, is the fastest growing industry in B.C. with about 20 per cent a year sales growth. It has become a billion-dollar-a-year industry. A recent count listed over 800 companies, many of them achieving remarkable success targeting niches in this international and highly competitive market. B.C. companies produce a wide range of products, from software to printed circuit boards, power inverters and specialized computers.

A Burnaby company, ***Creo Products Incorporated***, is about to create a revolution in data storage. It has developed an optical tape recorder in which information is inscribed by a laser rather than the traditional magnetic means. Such is the precision of the system that one reel of optical tape will be able to store the equivalent of 1billion typewritten pages.

A.L.T. Technologies of Vancouver designs and assembles digital image management workstations, featuring the latest in microcomputer hardware and software.

COMMUNICATIONS

Communications is a hot area. This isn't surprising if you look at a relief map of British Columbia — travel is not easy. B.C. telecommunications companies have contributed to Canada's world leadership.

MPR Teltech Ltd., part of the BC Tel group of companies, is a leader in the development of new telecommunications techniques and systems. The firm is Western Canada's largest research and development company and is among the ten biggest in Canada.

State-of-the-art taxi, police, courier and security communications systems have the ***Mobile Data International*** label on them. MDI was bought by ***Motorola*** in 1988, but the firm has retained its identity and now has 35 offices throughout the world.

The Nexus Group began in a garage less than ten years ago. Today it employs 250 skilled people making cable television equipment for the world market.

Other prominent telecommunications firms include *Glenayre Electronics*, active in cellular, paging, mobile data and voice processing markets, and *Norsat International*, which *Canadian Business* magazine acclaimed as Canada's fastest growing company in 1989.

BIOTECHNOLOGY

Biotechnology industries employ hundreds of people in B.C., notably in breeding and gene engineering, waste control and disease control. The volume of research already exceeds $12 million a year and experts predict rapid growth. Some examples: cloning of "super-trees" that grow faster and straighter; the use of bacteria to extract metals from ore and waste rock; environmental monitoring techniques; and gene probes.

You couldn't cite a better example of university-to-market technology transfer anywhere than what the Vancouver-based firm *Quadra Logic Technologies* is doing. Founded by a team of *University of British Columbia* scientists in the early 1980's *Quadra Logic Technologies* moves innovative products from the laboratory onto the world's pharmaceutical stage. Its current thrust is photodynamic therapy, in which drugs activated by light are used in the diagnosis and treatment of disease. The firm has also introduced products for cancer control, sexually-transmitted diseases, virus infections and atherosclerosis.

The *Canadian Liposome Company* specializes in another line of attack against cancer. Because some drugs break down in the body before they can go to work, they need to be protected on their way to a cancer site. Liposomes are microscopic

Vancouver police (above) rely on MDI computer to bring information within reach. Scientists (left) working at the BC Cancer Research Centre. An operator at Endako Mines Division of Placer Dome Inc., (below) adjusts the control panel of the bearing mills.

spheres of water-resistant organic material into which the company inserts a cancer-controlling drug. These tiny "drug delivery systems" can be injected intravenously.

ENVIRONMENTAL INDUSTRY

The people of British Columbia, proud of the unsurpassed natural wonders of their Province, are keen to protect their environment. Their efforts have led to a wide variety of products, processes, and systems that enhance or protect the environment and a high level of expertise in environmental technology that serves a growing worldwide demand.

Fast growing ***Seakem Analytical Services***, located in Sidney on Vancouver Island, is typical. Scientists and technicians at ***Seakem*** have adapted or invented many techniques to analyse a wide variety of chemicals for industry and government.

When oil spills such as the Exxon Valdez disaster in Alaska occur, ***Morris International Trading*** of North Vancouver provides equipment and materials to contain and clean them up.

Dioxins are now an unacceptable byproduct of the pulp-making process. Our pulp and paper industry is spending over $1 billion in a four-year period to switch to alternate bleaching processes. This costly but necessary action is stimulating rapid scientific and technological progress.

MB Research (left), a division of MacMillian Bloedel, is a pioneer in thermochemical and chemimechanical pulping techniques

SPACE AND AEROSPACE

When satellites, ships or aircraft photograph the earth, chances are that the information will be received and processed by equipment manufactured by ***MacDonald Dettwiler and Associates*** of Richmond. In less than 20 years, the firm has become a world leader in this field. It also designs and builds computer systems used in air-traffic control and flight operations.

An emerging strength is electronics for the aerospace industry. In 1989, ***Hughes Aircraft***, working with ***MacDonald Dettwiler*** won a $700 million contract to develop the software and computer hardware for a state-of-the-art air traffic control system for Canada. Hughes has set up a subsidiary in Richmond to coordinate the contract and to sell the technology around the globe. At the same time ***Canac/Microtel*** was completing a $270 million contract to build the satellite systems for a northern radar warning system.

Remote sensing and mapping is another B.C. specialty. The provincial ***Ministry of Forests*** started it all by applying remote sensing from airplanes and satellites to inventory mapping years before the rest of the world. Now many local firms are using the technology.

British Columbia firms are involved in the radar satellite being developed by the ***Canadian Space Agency*** and in a joint project of the four western provinces to develop systems for environmental monitoring satellites. B.C. has been allocated 10 percent of the purchasing for the Space Agency's $1.2 billion space program and is aiming for more than that.

SOFTWARE

The triangle formed by Vancouver, Victoria and Seattle is North America's third-largest software development area. On the B.C. side of the border, some 300 companies, employing more than 5,000 people, are engaged in designing the programs that tell computers what to do. Software sales add more than $300 million a year to the province's economy, and that's expected to grow by 25 percent annually through the 1990's.

One of the stars of the B.C. software scene is ***Consumers Software***, recently recognized as B.C. "exporter of the year." The company sells electronic mail systems, mainly to the U.S. Another remarkable company, ***Bedford Software***, developed Canada's best-selling small business accounting program.

FORESTRY

Our number one industry, and destined to remain so for many years to come, is forestry, a $13 billion-a-year business employing 90,000 people.

Every aspect of forestry, from tree propagation and planting through stand tending, protection, harvesting, milling, and pulp and paper production, is being closely scrutinized for technology opportunities. And there are many. Biological controls are being developed for weeds and insect pests. Lasers scan logs for hidden debris. Computers are used to control efficient cutting, maintain quality control at all stages of processing, and keep an accurate inventory of lumber. Robots are being tested for use in hazardous situations. Processes for transforming wood into paper and other products are being made more efficient and more environmentally friendly. B.C.'s companies, universities and research institutes are accepting the challenge of keeping this crucial industry on a competitive footing.

Canada's principal forest industry research organizations — ***Forintek Canada Corporation***, the ***Forest Engineering Research Institute of Canada*** and the ***Pulp and Paper Research Institute of Canada*** — all operate modern laboratories in B.C. ***MacMillan Bloedel's*** new research facility in Burnaby is one of the largest and modern in the world. It has invested over $50 million to do research and develop a product called ***Parallam***, a composite wood product made from parallel strands of wood glued together. The company spent over $100 million on the development of two ***Parallam*** plants, one in Vancouver and the other in Georgia, U.S.A. The material is visually attractive and is successfully challenging steel and iron in certain construction situations.

Technology can have a huge impact. The ***Science Council of British Columbia*** has recommended a vigorous research program to increase forest productivity by as much as 50 percent.

A loader (above) picks a stack of logs from a tractor trailer. Powertech's extra-high voltage lab's impulse generator (below) can generate enough energy to light up the entire province for a split second.

MINING

B.C. mines produce more than $4 billion worth of products a year, mainly coal, copper, gold, zinc, lead, and silver.

To compete worldwide, the best technology has to be applied and the technology usually has to be home grown, to cope with the particular conditions at each mine and the characteristics of each ore. Today's top research priorities are improving productivity, in taking ore out of the ground and extracting minerals from the ore, and in environmental protection.

The ***Mining Association of B.C.*** is active in promoting technology development and technology transfer, including projects such as an aircraft-type simulator to train off-road truck drivers, and new blasting techniques, as well as research on acid rock drainage and controlling cyanide wastes from gold mines.

Mining technology "byproducts" like these are exported around the world and may one day become as important as some of the minerals themselves.

ENERGY

Hydroelectric power, natural gas and coal are in generous supply in B.C. There is some oil too, and much larger sources are located just across the Rocky Mountains. All of which assures British Columbia communities and industry that they can count on reasonably priced energy to meet their growing demands. Meanwhile, Vancouver Island and Sunshine Coast consumers are already looking forward to the completion of a natural gas pipeline from the mainland to bring them the benefits of that clean-burning fuel.

Energy research in B.C. is aimed at more efficient use and re-use of these resources. ***Powertech Labs Inc.***, formerly

the research and development arm of *BC Hydro*, is a leader. Other firms are looking for ways of making alternatives to oil more attractive and more widely available. The technology for using natural gas as a fuel for cars, trucks, and buses has been adapted and improved. For example, a B.C. firm has developed a device to allow cars to be fuelled from household natural gas lines.

But the ultimate "clean" fuel is hydrogen, which burns to create energy and leaves behind pure water. Used in a high technology fuel cell, it can be converted efficiently to electricity. B.C. has natural advantages in this evolving technology. The two major sources for generation of hydrogen, natural gas and electricity, are plentiful.

A North Vancouver firm, *Ballard Power Systems*, is leading the way into a new era of energy conservation and alternate sources of power. Its solid polymer fuel cell, based on hydrogen technology, is already being tested as a replacement for conventional engines on transit vehicles. There are plans to use a *Ballard Fuel Cell* in the *SPIRIT Autonomous Undersea Vehicle* now under development in B.C. The *University of Victoria* is becoming a focus for research in hydrogen technology.

Divers from Can-Dive Services Ltd. (above) place a Deep Rover on an undersea platform. A broodstock salmon (left) shortly after hatching. Lew Rossner, (below) vice-president of corporate development and export at Rogers Foods Ltd.

SUBSEA

British Columbia leads the world in developing products for non-military undersea exploration. And no wonder. With its long and varied coastline, telecommunications expertise, and rapidly developing skills in artificial intelligence and robotics, B.C. has a unique advantage.

The leading company in this field, *International Submarine Engineering* of Port Coquitlam, has launched nearly 200 submersible vehicles in the past 20 years, more than all their competitors combined. Some are operated by small crews. Others are entirely remote-controlled. Another firm, *Can-Dive* of North Vancouver, specializes in diver's suits that enable people to descend in comfort and safety to previously unattainable ocean depths.

With the support of the *Advanced Systems Institute*, British Columbia firms with proven expertise related to subsea technology have formed the *SPIRIT Subsea Corporation* to develop a dream subsea vehicle that will be able to travel, on its own, thousands of kilometers to an undersea resource site, shipwreck or geological formation. Once there, the vehicle will investigate and sample as required, make decisions on the situation and even change its mission if necessary, and then return to base.

AQUATIC RESOURCES

The rivers, lakes and coastal waters of B.C. are home to an immense and valuable resource. Wild and farmed fish and aquatic plants support an industry with close to $ 1 billion of annual sales.

Salmon is the mainstay of the wild fishery and it is also the focus of the burgeoning aquaculture industry: the 1995 harvest will be about $200 million. Shellfish — clams, scallops, oysters and mussels — are increasingly popular aquaculture crops.

Fish farming has multiplied the opportunities to apply research and adopt new technology. Scientists in industry and the universities are working to control the incidence of disease, improve nutrition, lower production costs, and select better stocks through genetic manipulation.

AGRICULTURE AND FOOD PROCESSING

Among the mountains, B.C. has some of Canada's richest, most productive farm land. From this land, ranchers, orchardists, dairy and vegetable farmers and honey producers harvest a wider range of food and beverages than any other part of Canada. This is a $1.6 billion a year business, employing 31,000

people in agriculture and 20,000 in food processing.

An estimated $30 million is spent on agricultural research every year. It's because of better technology that B.C. farmers can now market such exotic products as ginseng, kiwi fruit, exotic mushrooms, and also stay competitive in the production of traditional fruits and vegetables.

Another line of research has helped vegetable growers to reduce their need for chemical pesticides by some 80 percent. *Applied Bionomics* in Sidney is raising natural insect predators to control aphids and other pests. *Safer Soap* has developed soaps that can be used as pesticides and are completely harmless to warm-blooded animals and humans.

Government research stations throughout the province sustain a continuous flow of new techniques.

The Canadian Liposome Company (left) develops tiny "drug delivery systems" to combat localized cancer.

MEDICAL RESEARCH

Is there a more worthwhile field in which to invest research time and money? Probably not. And, as our population ages and the demands on the health care system increase, the value of medical research is going to increase.

Medical research is a $30 million a year business in British Columbia. That's the direct value of research being done by companies and agencies in the province. Also, the *University of British Columbia*, with hundreds of medical researchers and students, and affiliated hospitals have some of the finest laboratory and clinical facilities anywhere. At *St. Paul's Hospital* in downtown Vancouver, for example, the *Pulmonary Research Centre* studies respiratory disorders such as asthma and lung disease. At the *University of British Columbia's Centre for Transplantation Immunobiology* scientists are looking into how the body rejects transplanted tissue and the effects of anti-rejection drugs.

The *B.C. Cancer Control Agency* is renowned for the quality and effectiveness of the tests and trials it runs.

The field has many small to medium-sized specialized companies. For example, *Advanced Light Imaging*, a Burnaby firm, is developing an infra-red light scanning device to detect breast cancer at an early stage. *Andronic Devices* of Vancouver has shown how robotic systems can be applied in a variety of medical situations, from handling hazardous blood samples, to holding limbs steady and in proper position for orthopedic surgery.

A major player is the *Terry Fox Medical Research Foundation*. The Foundation's goals are to improve methods of diagnosis, treatment, and prevention of diseases. It was a co-founder, with the *British Wellcome Foundation*, of the *Biomedical Research Centre* located at the *University of British Columbia*. The Fox Foundation is also

Networks of Centres Of Excellence

As the 1980's drew to a close, the Federal Government selected 14 Networks of Centres Of Excellence from several hundred proposals submitted from across Canada. Federal funding will total $240 million over four years. B.C. universities and firms are involved in all of them. The idea is to encourage Canadian scientists and engineers to work together, regardless of where they are, in strategic research areas considered vital to the country's growth in science and technology.

All three B.C. universities are heavily involved in the Centres Of Excellence. UBC leads three of the 14 -- those concerned with bacterial diseases, genetic basis of human disease and protein engineering — and is participating in another nine. That's the most of any Canadian university.

The University of Victoria leads the Centre Of Excellence in molecular and interfacial dynamics and is part of four others: bacterial diseases, telecommunications, robotics and intelligent systems and microelectronics.

Simon Fraser University has a major role in the robotics and intelligent systems centre as well, and SFU faculty will be contributing to others.

involved in a joint venture with *Quadra Logic Technologies of Vancouver* to build a pharmaceutical manufacturing plant.

The *British Columbia Health Care Research Foundation* invests approximately *$10* million from lottery funds each year in a variety of important research projects, and, together with the *Science Council*, it administers the $3 million per year *Health Development Fund*.

TRIUMF/KAON

At *TRIUMF*, scientists from all over the world can study nature in its finest detail and its most stunning power. *TRIUMF*, adjacent to the *University of British Columbia* campus, offers visiting researchers access to one of the world's major cyclotrons, where sub-atomic particles can be accelerated to speeds close to that of light. In addition to an impressive body of new knowledge contributed by the people who use *TRIUMF*, there are practical benefits. Short-lived radio isotopes, produced by specific collisions in the cyclotron, are used to treat cancerous tissue at nearby hospitals.

Plans to expand *TRIUMF* are well-advanced, thanks to major funding from both the provincial and federal governments, as well as commitments from several foreign governments and agencies. A new, much larger accelerator would produce copious quantities of an exotic sub-atomic particle called a "kaon". The *KAON* factory proposal, when transformed into reality, will create as many as 20,000 person-years of employment during construction and generate some $400 million in spinoffs.

Plastic strips (above) record light flashes from the passage of subatomic particles through lucite cylinders. An engineer (below) works on one of the 12 hydraulic lifting jacks outside the cyclotron.

Framework For Action

The government of British Columbia is working towards "a framework for a prosperous future for B.C. where science and technology play a vital role". Those words appear in a far-reaching document, *Strategies for Innovation*, published in 1988, which outlined the government's vision of the future and its policies for getting there. (See page 7, for the full Science Policy of the government.) An important part of government's role in achieving the vision is to set up appropriate institutions, or "infrastructure."

Employees of International Submarine Engineering (left) work together to assemble parts from technical drawings.

PREMIER'S ADVISORY COUNCIL ON SCIENCE & TECHNOLOGY

The Council, the author of *Strategies for Innovation*, is at the apex of the institutional framework. This group was created in 1987 to give confidential advice to the Premier of the province on matters having to do with science and technology. Among the issues it has tackled, in addition to the obvious one of science policy, are public awareness of science and technology, a resource inventory, Canada's space program, and hydrogen technology. The Council also championed the new 5-year, $420 million Science & Technology Fund.

SCIENCE COUNCIL OF B.C.

The Science Council has two important roles. It administers science and technology support programs, awarding millions of dollars in provincial funds to qualified individuals, companies and agencies, and it directs grassroots strategic planning for industrial application of science and technology.

The *Science & Technology Development Fund - Assistance Grants for Applied Research* (STDF – AGAR) is designed to encourage applied research by the universities and industry. Projects undertaken with the assistance of this program have resulted in the development of new products, processes and systems and, in many cases, the establishment of new companies. Among the other programs: *Graduate Research, Engineering and Technology* (GREAT) scholarships are available to men and women in postgraduate scientific or engineering studies; there are *Science & Technology Awards for Returning Students* (STARS) for people currently in the workforce who want to return to complete a postgraduate degree; *Industrial Postdoctoral Fellowships* encourage private industry to employ recent PhD's in fields appropriate to their training.

The *Science Council*, with support from both provincial and federal ministries and agencies, also operates the unique *Strategic Planning for Applied Research and Knowledge* (SPARK) process. With the help of a network of volunteers from virtually every economic sector in the province, *SPARK* looks at each sector for strengths and weaknesses, points out opportunities for the better use of science and technology and, when appropriate, goes to work to help make the opportunities a reality. Government relies heavily on *SPARK* to guide it in implementing science policy.

PROVINCIAL MINISTRIES

The *Ministry of Advanced Education, Training and Technology* leads the implementation of the science and technology policy. The ministry has overall responsibility for a variety of agencies, programs and planning activities. It works with other provincial and federal ministries, with industry, with the educational community and with various research organizations.

For instance, the ministry helps industry identify research and development directions and may assist

John Mingay, (above) president of TIR Lightpipe, which completed an initial sale to McDonald's restaurants of $900,000 worth of roofbeam lights. A welder (left) works from the ARKTOS Beta platform made by Watercraft Offshore Canada Ltd. A research technologist (below) absorbed in her work.

with financing some research activities, or providing seed capital, but firms will look to the *Ministry of Regional and Economic Development* for help in expanding to make a new product, or to the *BC Trade Development Corporation* for help in exporting the product.

DISCOVERY FOUNDATION

Discovery Foundation is a non-profit society established by the provincial government to promote science and technology by linking business, educational institutions and government. It oversees *Discovery Parks*, the *Discovery Innovation Centre*, *Discovery Enterprises* and *Discovery Technology*.

Discovery Parks are located adjacent to the three universities and the *B.C. Institute of Technology*. The buildings in each park are home to an astonishing variety of innovative companies working in every sector of the knowledge industry.

With funding from the Province, Discovery Enterprises is supplying venture capital to build innovative new enterprises, and underwrite high risk advanced technology.

The *Discovery Innovation Centre*, meanwhile, is a store-front operation to which new inventors can turn to get helpful advice and direction through seminars, short courses, literature, technical support and planning assistance.

Finally, the *Discovery Technology Division* maintains a comprehensive information network and international contacts for the Foundation and its members. It publishes *BC Discovery*, a bimonthly magazine that tells what's happening in the business of science and technology in B.C., and who's making it happen.

FEDERAL GOVERNMENT

The *National Research Council* operates two world-class astronomical observatories in British Columbia, the *Dominion Astrophysical Observatory* near Victoria and the *Dominion Radio Astrophysical Observatory* near Penticton. Now there are plans to move the Council's *Herzberg Institute of Astrophysics*, which directs the Council's many astronomical research programs, to Victoria from Ottawa. This would confirm British Columbia's pre-eminence in astronomy, and give added lustre and opportunities to astronomers already clustered at the *University of Victoria* and *University of British Columbia*.

The *National Research Council* also works to make businesses more competitive through science and technology. Their *Industrial Research Assistance Program*, known as IRAP, provides some funding but, just as important, staff also help firms define technical opportunities, obtain technical assistance or solve product or production problems.

The federal presence is also felt in research stations operated by *Agriculture Canada* in Prince George, Agassiz, Kamloops, Sidney, Summerland and Vancouver. *Energy Mines and Resources Canada* has geosciences labs near Victoria and Vancouver, while *Environment Canada* operates a weather lab, and conducts wildlife research, and environmental monitoring and studies. Fisheries and *Oceans Canada* operate a research station near Nanaimo and the *Institute of Ocean Sciences* at Sidney on Vancouver Island, while *Forestry Canada* has the *Pacific Forestry Centre* in Victoria and the *Defense Research Establishment Pacific* works on anti-submarine detection from its facility in the same city.

Industry, Science & Technology Canada, which has Canada-wide responsibility for science and technology programs has targeted information technology, advanced industrial materials and biotechnology as strategic technologies, complementing British Columbia policy in these areas. *Western Diversification Canada* provides interest-free financing, especially to companies

eager to introduce new technology and manufacturing skills that will broaden western Canada's economic prospects.

BRITISH COLUMBIA ADVANCED SYSTEMS INSTITUTE

Advanced systems are what most people think of when you say "high-tech." They include microelectronics, telecommunications, computer science, artificial intelligence and robotics. The Institute was set up to encourage research and development in the advanced systems, and received its initial funding from the federal-provincial sub-agreement on science and technology, a part of the overall *Economic Regional Development Agreement*.

ASI has no labs of its own, nor does it maintain a major physical presence. It is what some have called "an institute without walls." Companies become affiliates of ASI because it can give them access to the discoveries and innovations of some of the Province's most distinguished scientists and engineers — the *ASI Fellows* based at B.C.'s three universities.

The Institute is now virtually independent, its goals and objectives driven largely by the research needs of industry. Both levels of government continue to provide it with financial support as does the private sector.

ASI is regarded as a model organization that can serve, with appropriate modifications, as an example for similar organizations in other sectors.

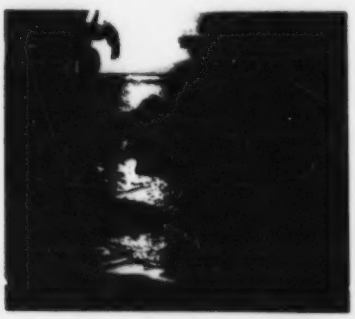
VANCOUVER ISLAND ADVANCED TECHNOLOGY CENTRE

Southern Vancouver Island has a rapidly growing community of imaginative and profitable entrepreneurial science. The *Vancouver Island Advanced Technology Centre* in Victoria provides that community with marketing services, information about government programs and a place to showcase recent achievements.

BRITISH COLUMBIA RESEARCH CORPORATION

British Columbia Research began its history as the provincial government's official research organization, at a time when there was little research and development activity in the province. It has played an important and ongoing role in developing technology for use in the resource industries. As industry has matured, *British Columbia Research* has been transformed, with the full approval and assistance of the provincial government, into an independent, private company.

British Columbia Research performs research on contract for small and medium-size companies in B.C. and beyond. In its 180,000 square foot facility near the *University of B.C.*, it employs a staff of 150, two-thirds of whom are scientists, engineers and technicians.



Analytical chemist Hang-Ming Lai (left) of Chemex labs works on colorific values of coal samples.

Science Awareness

PUBLIC INTERPRETIVE CENTRES

British Columbians and their visitors are well served by public institutions that explain science and technology in popular terms. The *Vancouver Public Aquarium* has achieved international acclaim for interpretive programs on marine life. The *H.R. MacMillan Planetarium* and *Gordon Southam Observatory* do their part to ensure a better understanding and awareness of our place in the universe. First class research and interpretation of natural history, archaeology and related subjects are the standard at the *Royal British Columbia Museum* in Victoria. And there are museums and other institutions where one can learn more about the technology of transportation, aerospace, mining and forestry.

SCIENCE WORLD

The newest and most spectacular interpretive centre of them all is *Science World*. Thanks to an impressive effort by community leaders, business people, educators, scientists and representatives of all levels of government, *Science World* was born in 1989 in a dramatic globe-shaped building left by *Expo 86*.

Here, science and technology come to life in hands-on exhibits, colorful demonstrations, courses, films and lectures. Like the other public science institutions, *Science World* works hard to ensure that it serves British Columbia as a whole, not just the people of Vancouver, with travelling exhibits and explainers.

On behalf of the provincial government, *Science World* also operates the *Scientists in the Schools* program, which every year sees scientist volunteers at schools in every corner of the province. The program enriches the science curriculum and inspires children to consider science-related careers.

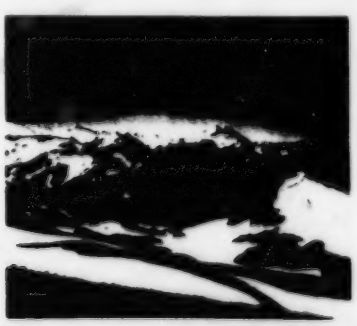
SCIENCE & TECHNOLOGY WEEK

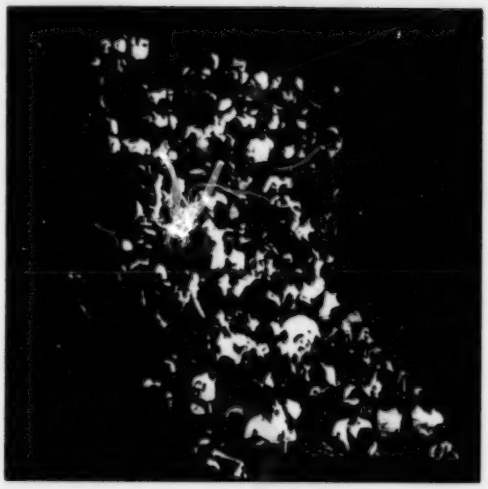
In mid-October, B.C. joins much of the rest of Canada in marking *Science & Technology Week*. This is an opportunity to draw attention to the achievements of the men and women who work in science and engineering, and to celebrate their many remarkable successes.

It is during *Science & Technology Week* that gold medals in the name of the province are presented to winners of the *British Columbia Science and Engineering Awards*. Outstanding individuals or research teams working in natural sciences, health sciences, applied science or industrial innovation are selected by the *Science Council of British Columbia*. Additional awards are made for *Entrepreneurial Science*, *Lifetime Achievement* and *Science Communication*.

The aim of *Science & Technology Week*, and the other public awareness programs of government and other institutions, is to stimulate interest science careers and more broadly to ensure that science is seen to be what it is — an integral part of a nation's culture and an essential part of its economic future.

A killer whale (above) leaps into the air at the Vancouver Aquarium. Science World (below) was created from this dramatic globe-shaped building left by Expo 86.





In the document, ***Strategies for Innovation***, the government's vision for British Columbia is spelled out: "A strong, global-based economy that provides its people with one of the highest standards of living in the world; extraordinary renewable resources that the province cultivates with care and profit; a small population of well-educated, healthy people, productively employed; a clean environment; a special relationship with Pacific Rim countries that fosters exchange and trade; and a reputation for being a receptive host to visitors who wish to share in its beauty, its adventure, and its industry."

People will make the vision a reality, using science and technology both for tools and for inspiration.